

10/521697

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Applicants : MYKROLIS CORPORATION et al.

International  
Application No. : PCT/US03/22533

International  
Filing Date : 18 July 2003

For : FLUID FLOW MEASURING AND PROPORTIONAL FLUID  
FLOW CONTROL DEVICE

Authorized  
Officer : Virginia Irby

Attorney  
Docket No. : 200200030-PCT

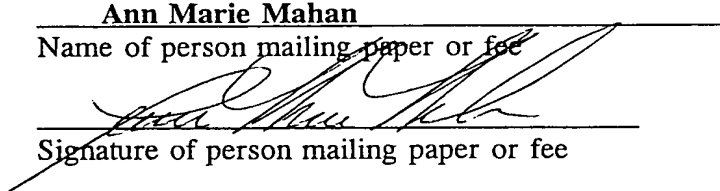
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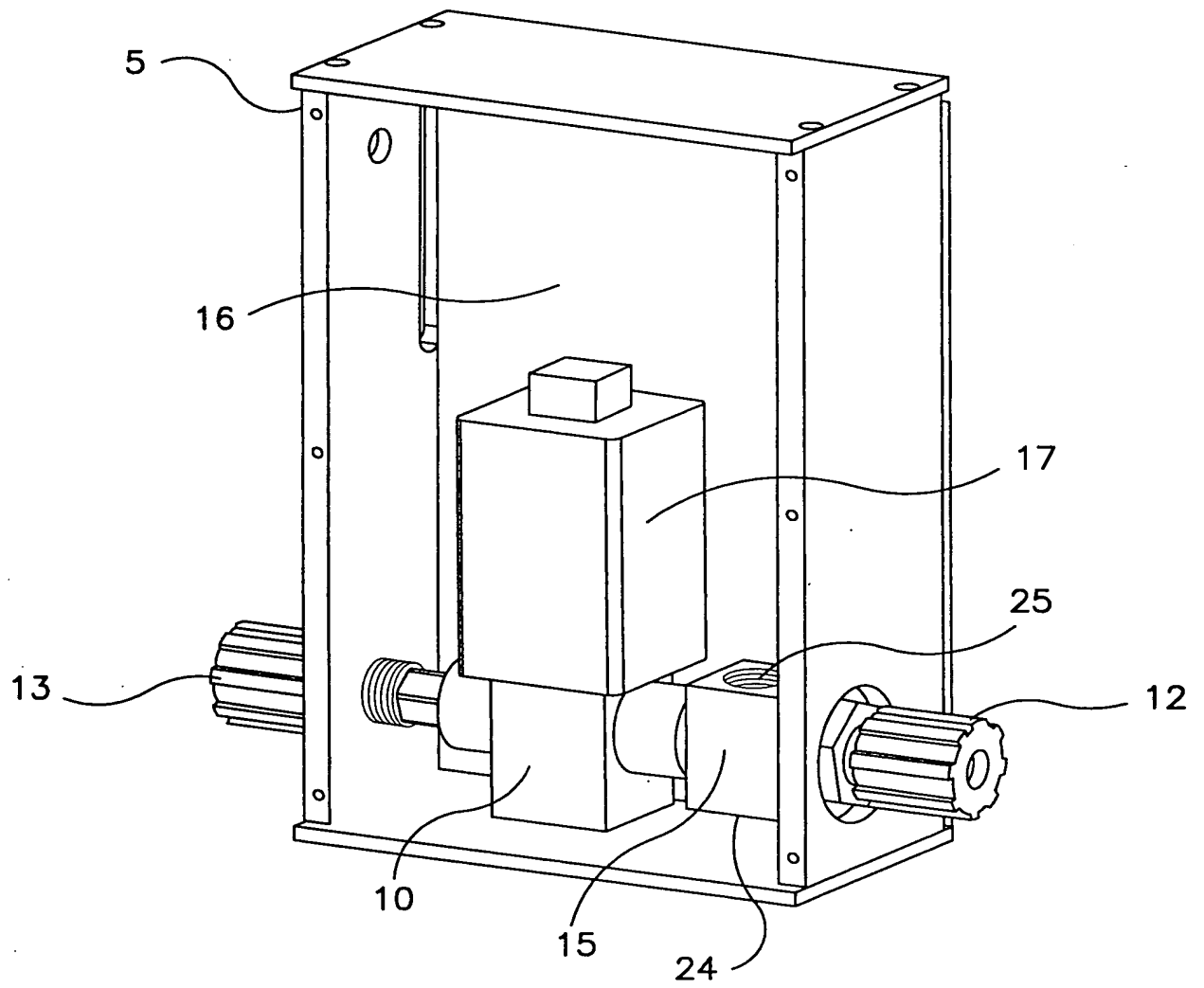


FIG. 1

Concentric venturi

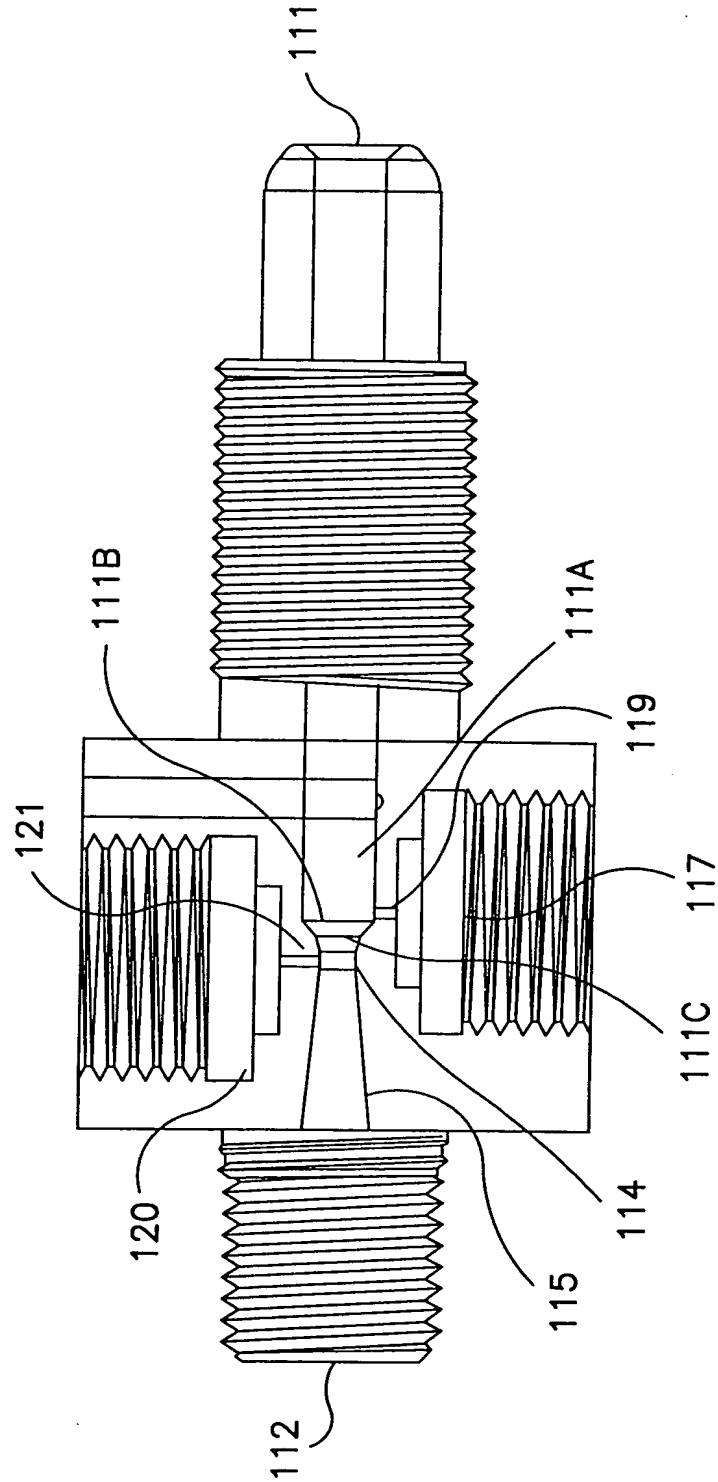


FIG. 2

Concentric venturi

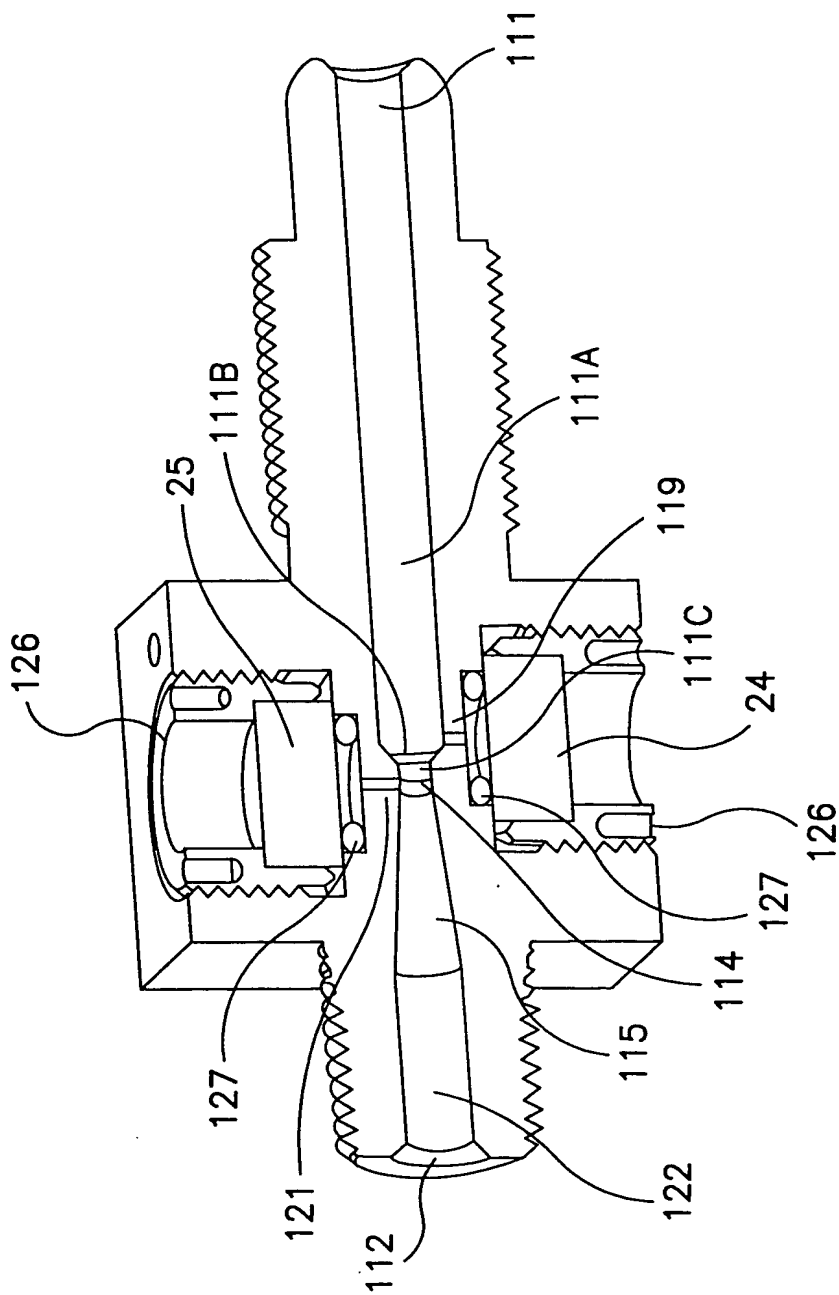
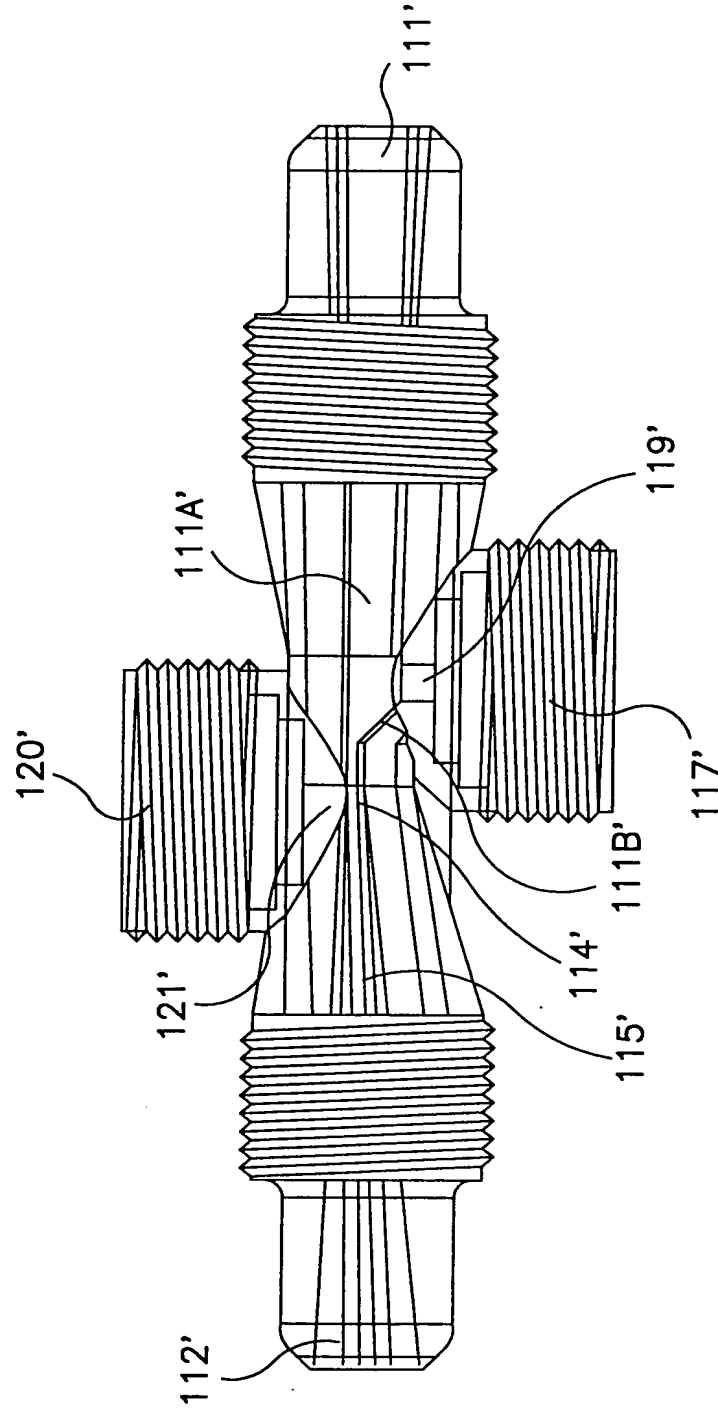


FIG. 3



Eccentric flat channel venturi

**FIG. 4**

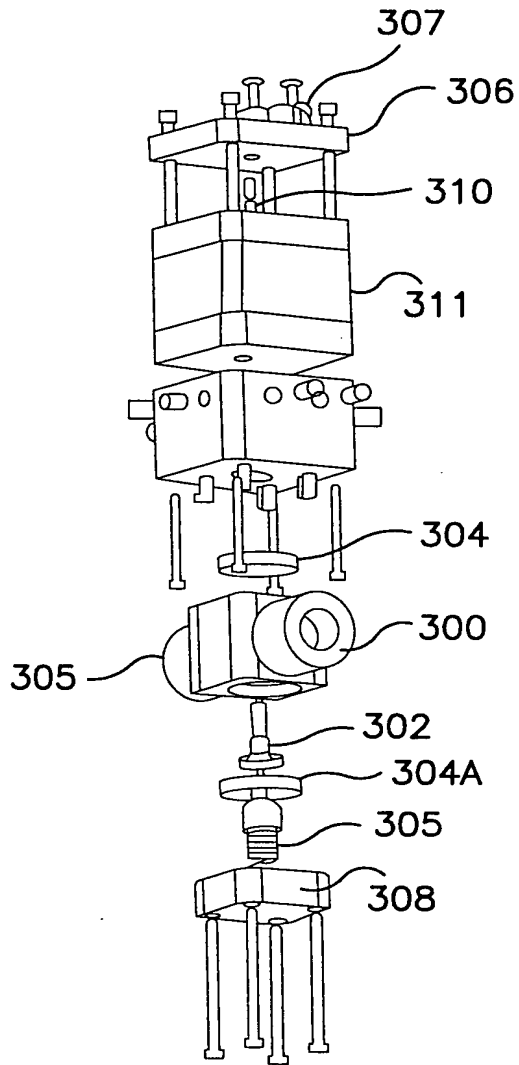


FIG. 5

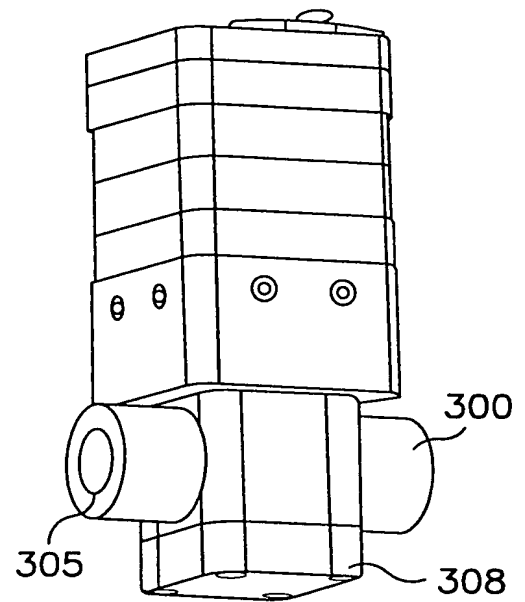


FIG. 6

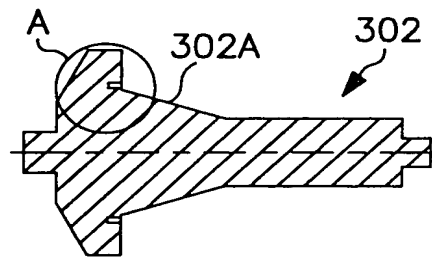


FIG. 7

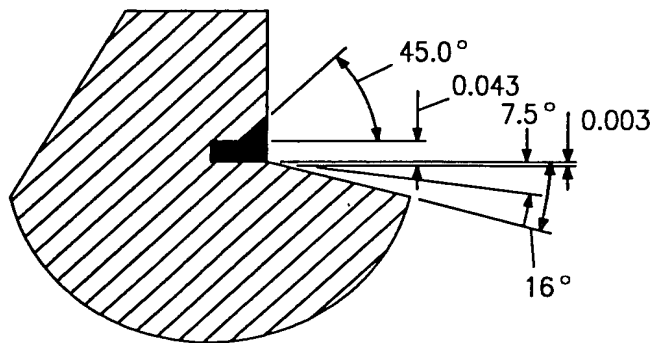


FIG. 7A

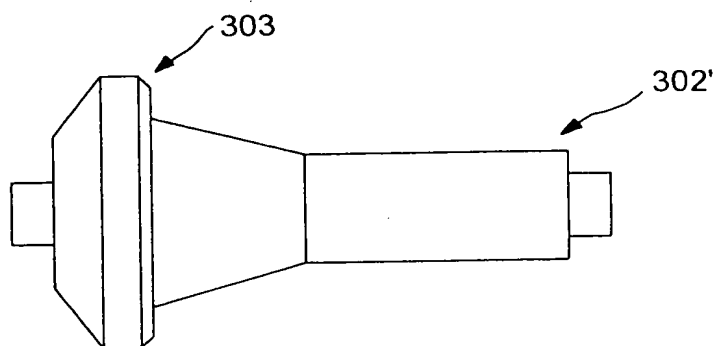


FIG. 8

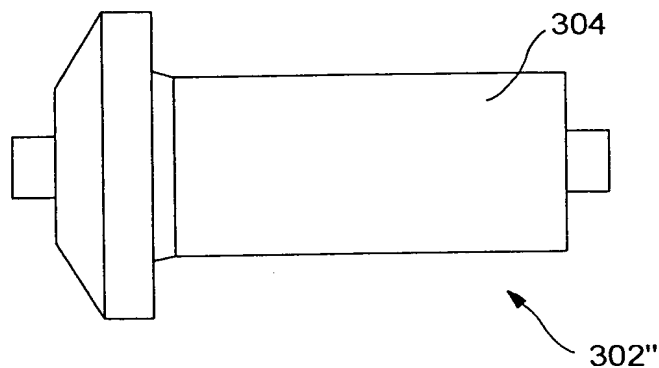


FIG. 9

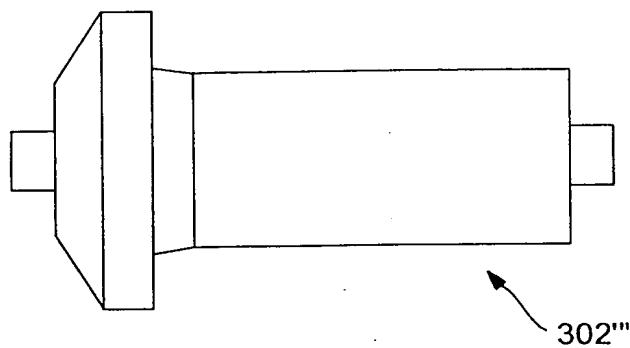
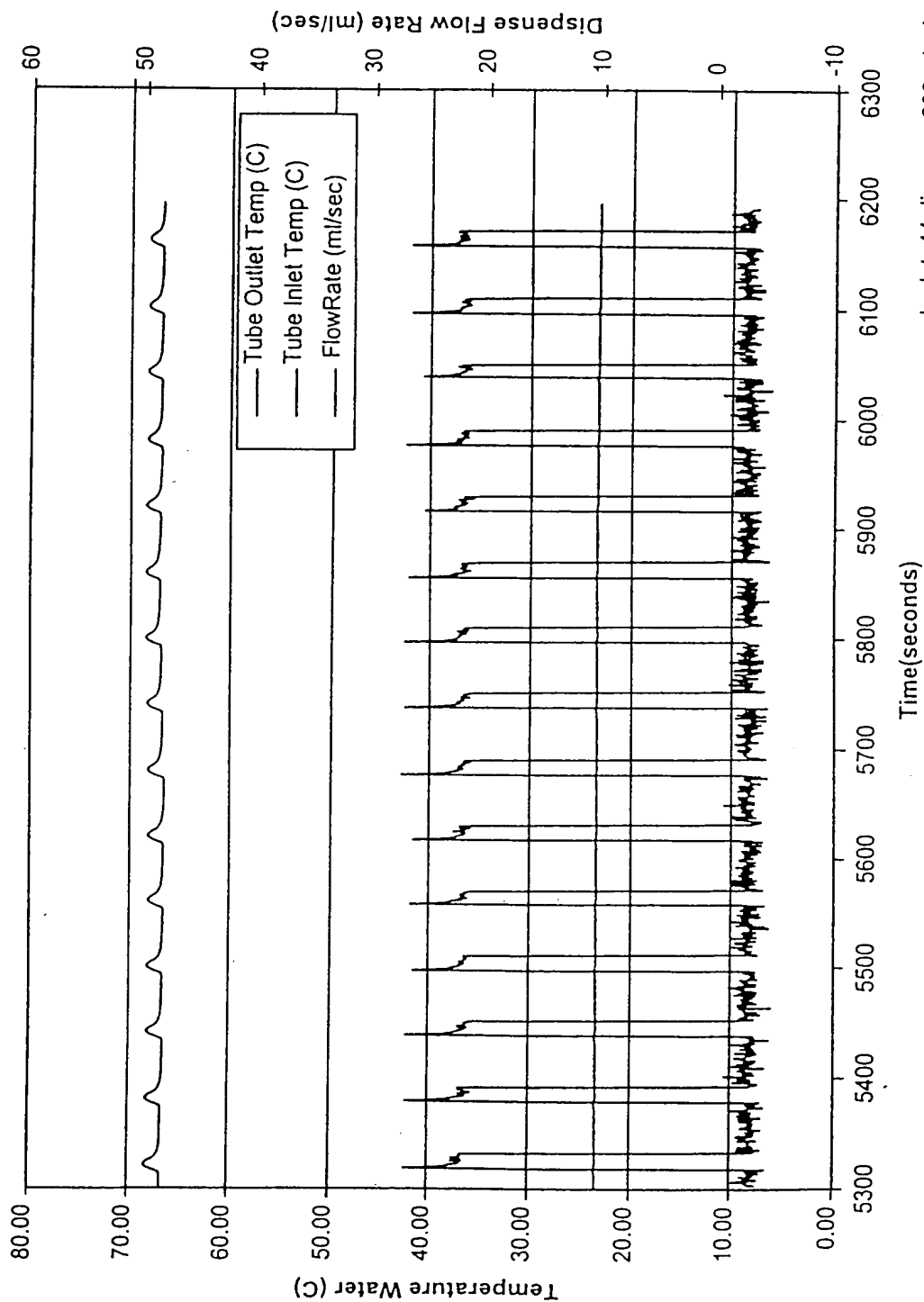


FIG. 10



Heat Exchanger (5265-65-3): Shell ID = 2.25 in, Length = 18 in  
Shell (HOT) Flow = 1460 ml/min; 70 $\pm$ 0.1 C  
300ml total dispense volume @ 67.4 $\pm$ 0.9C in 15 sec; off cycle 45 seconds



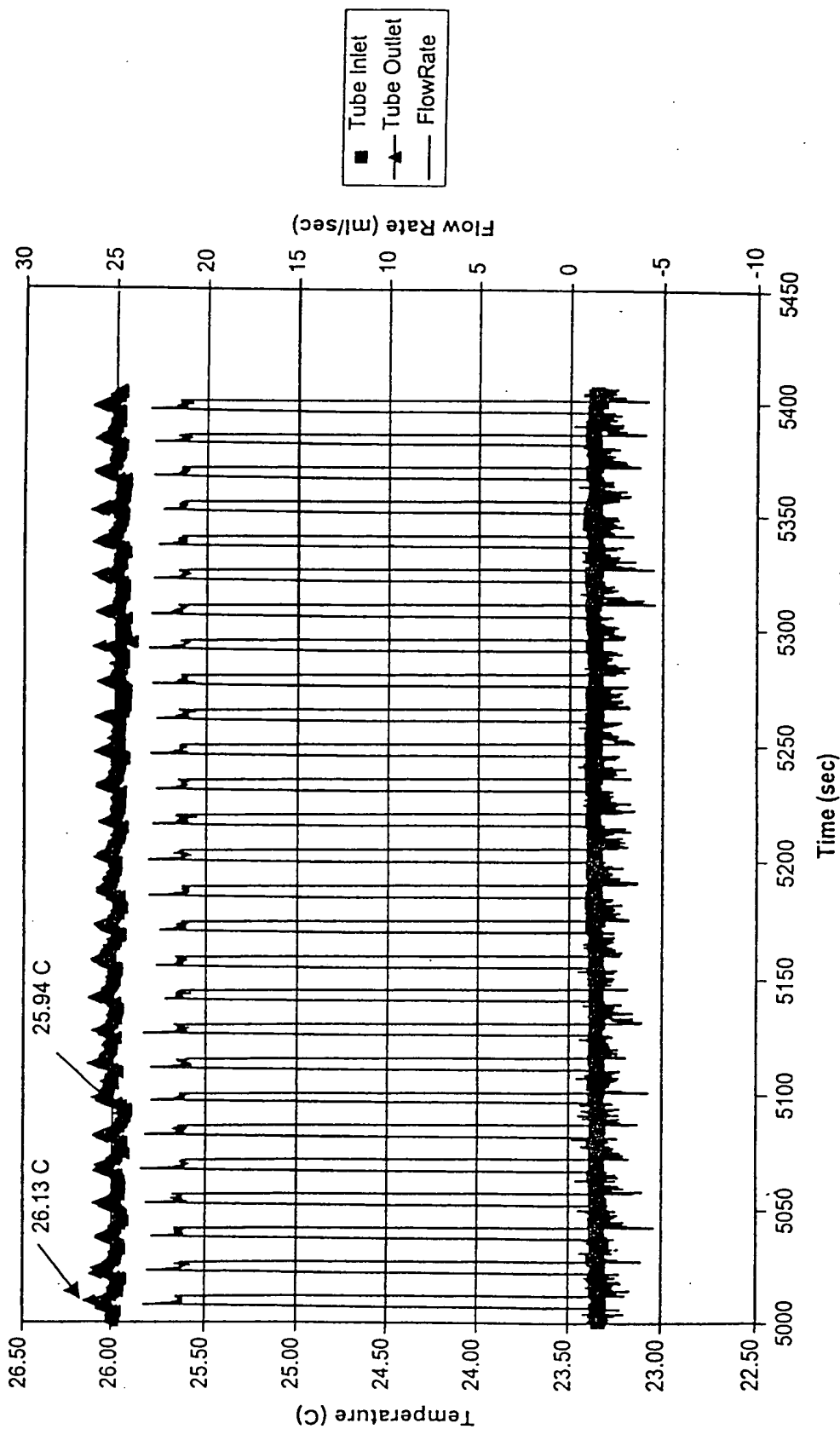
hedata44-dispense 300 ml min 18 inch unit.xls

FIG. II

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Heat Exchanger: Shell ID = 2.25 in, Length = 8 in  
Shell Flow = 500 ml/min @ 27.1 C  
Tube Flow = 1150 ml/min; Cycle 5 seconds on, 10 seconds off Dispense Volume = 100ml  
Tube Inlet Temperature = 23.4 C



hedata47-developer dispense.xls 500 flow 15 cycle

FIG. 12

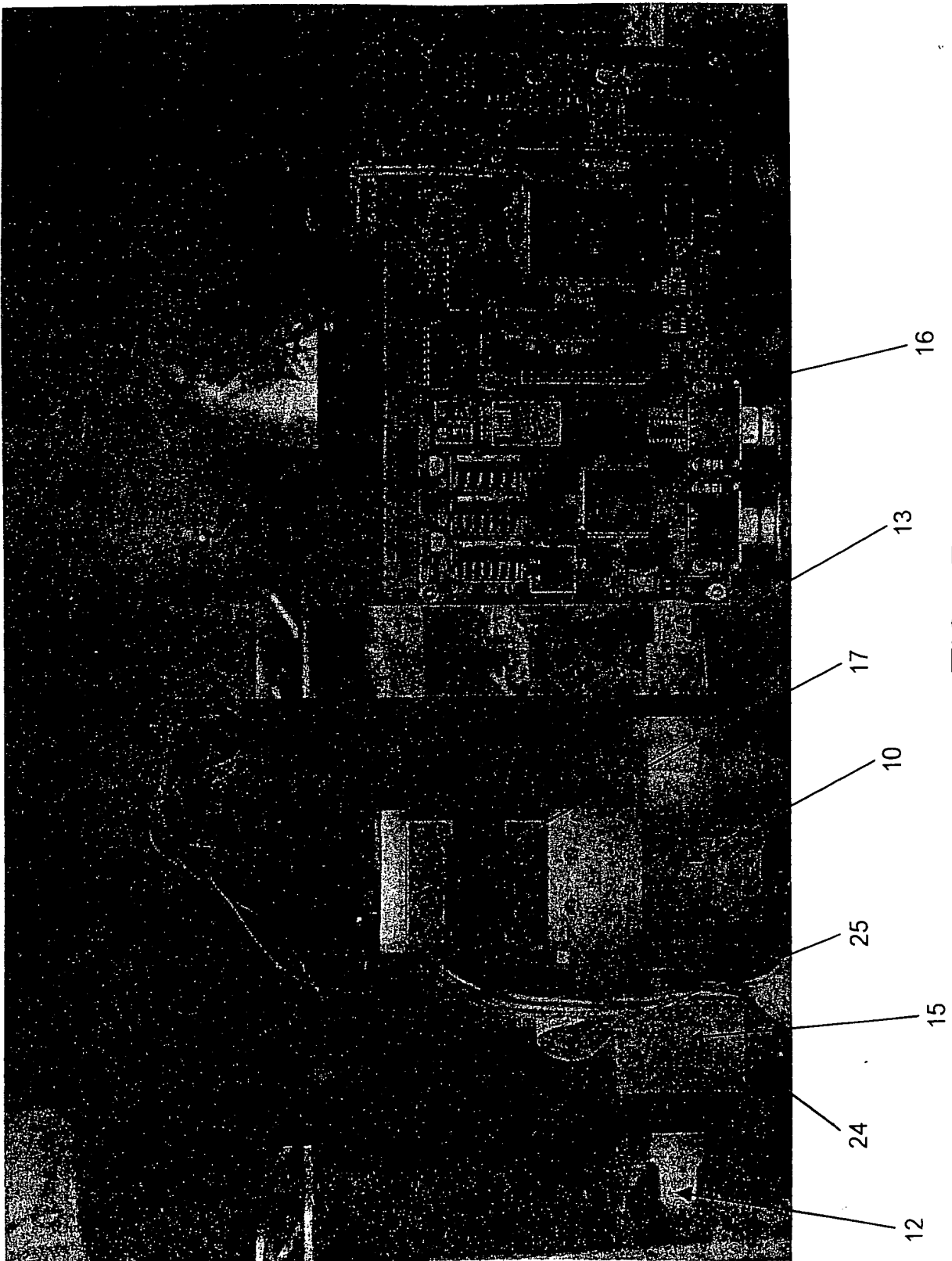


FIG. 13

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Flute #1  
0711flute1flow.xls

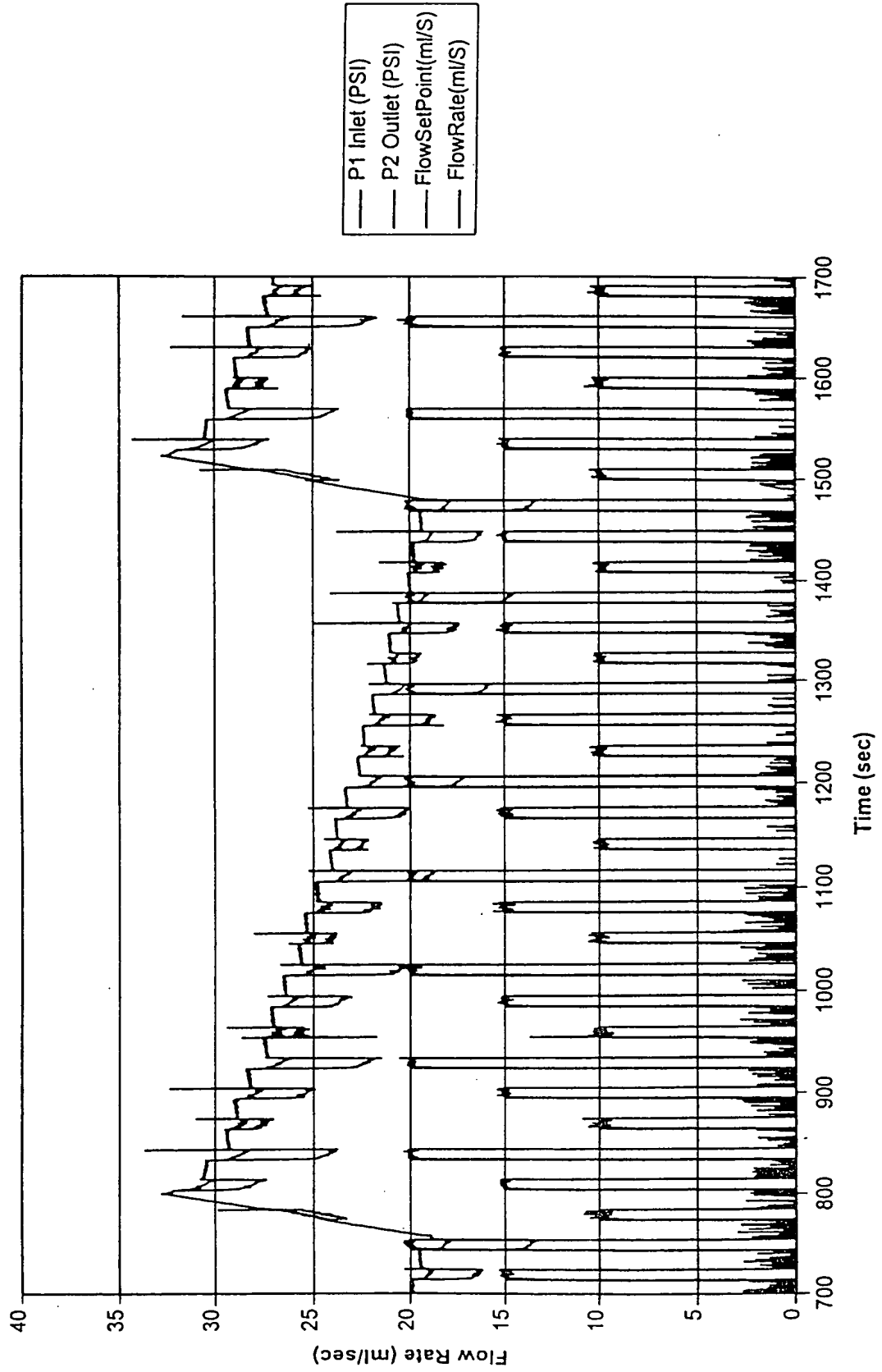


FIG. 14

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FLUTE 6UVT2 (1/4") VOLUMETRIC FLOW RATE vs PRESSURE DROP

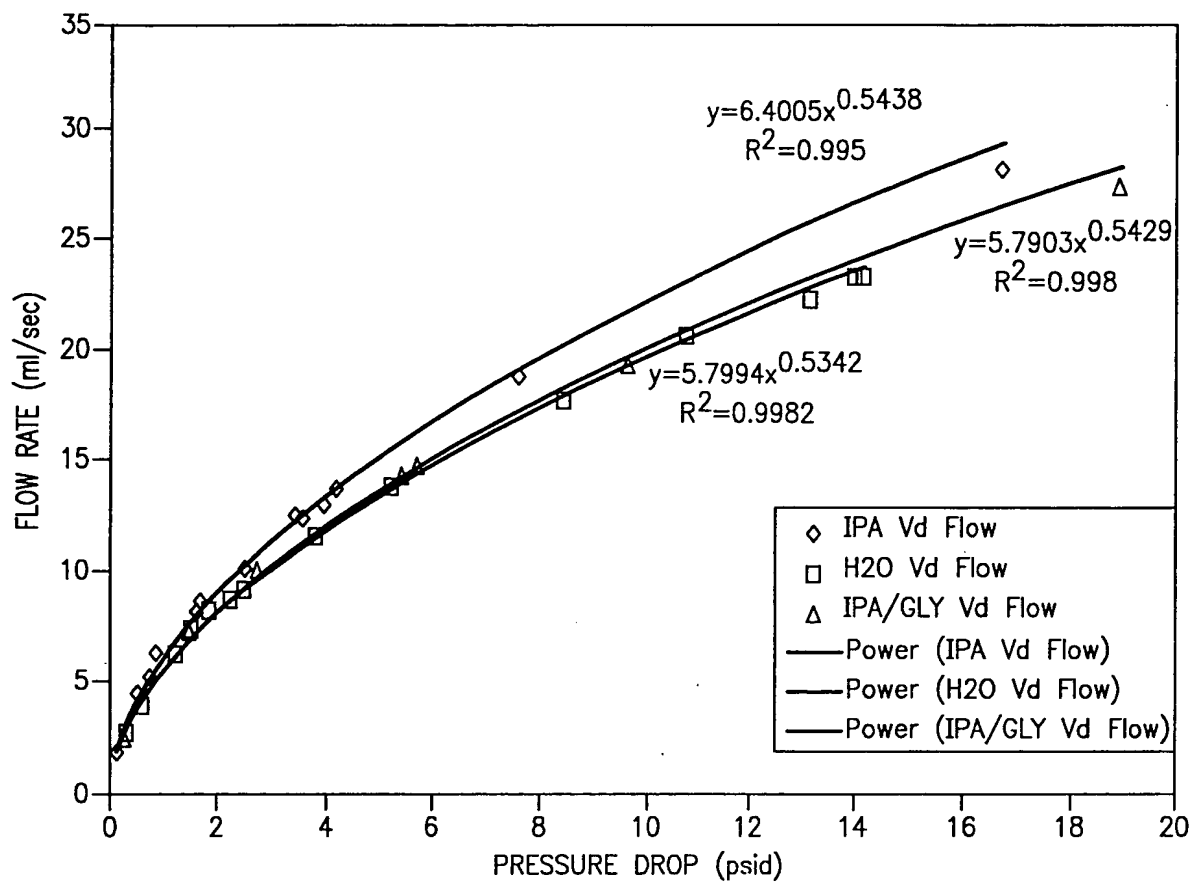


FIG. 15

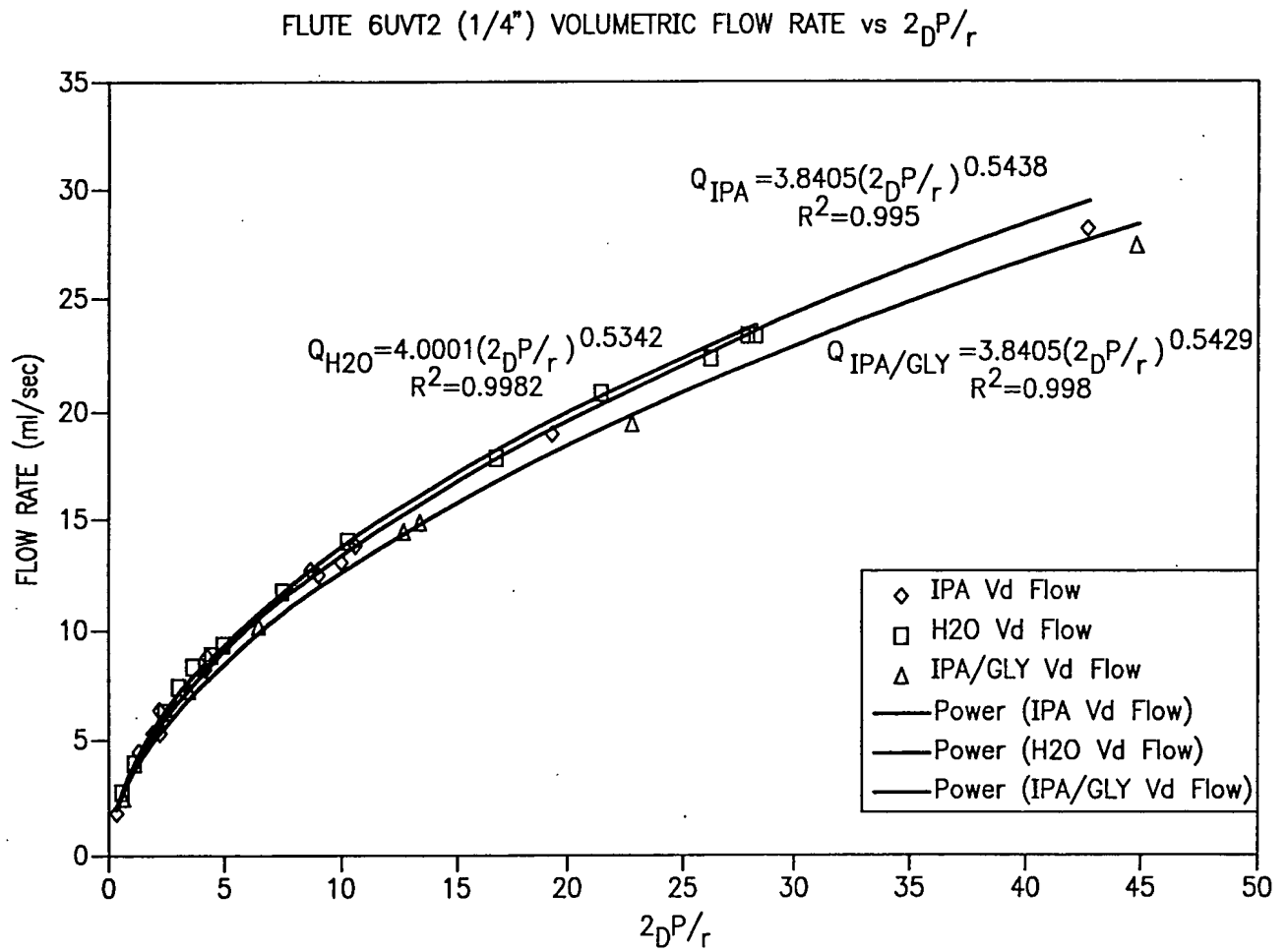


FIG. 16

CALIBRATION CURVE COEFFICIENT  $C'$  vs KINEMATIC VISCOSITY FOR FLUTE 6UVT2  
(1/4")

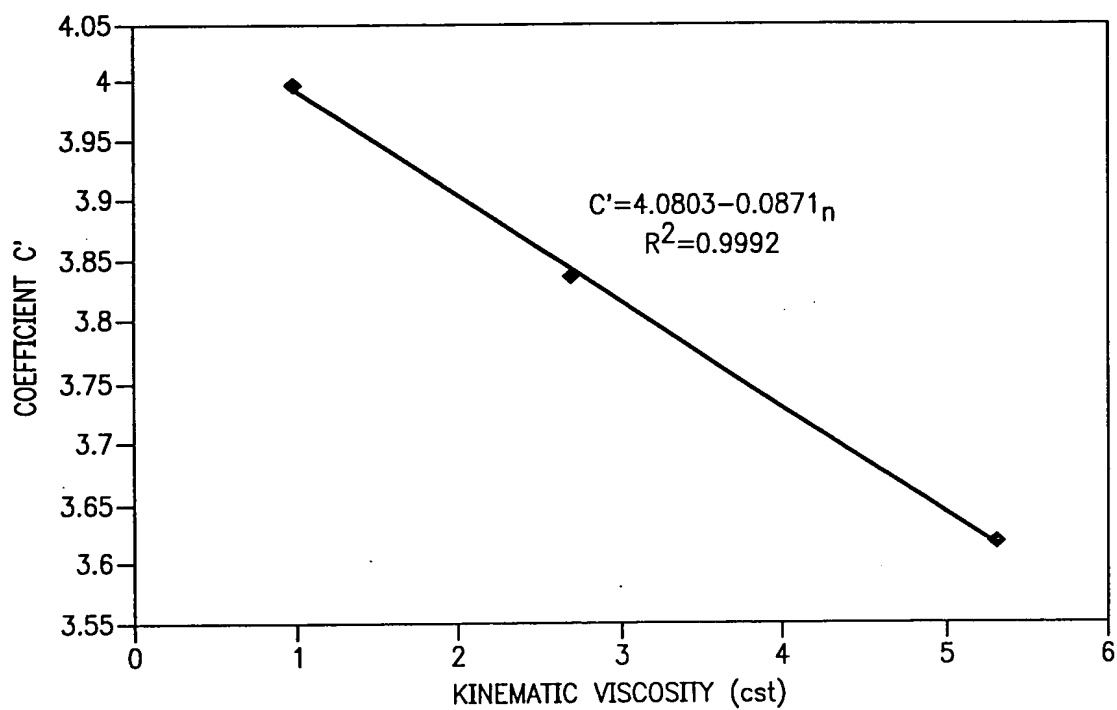


FIG. 17

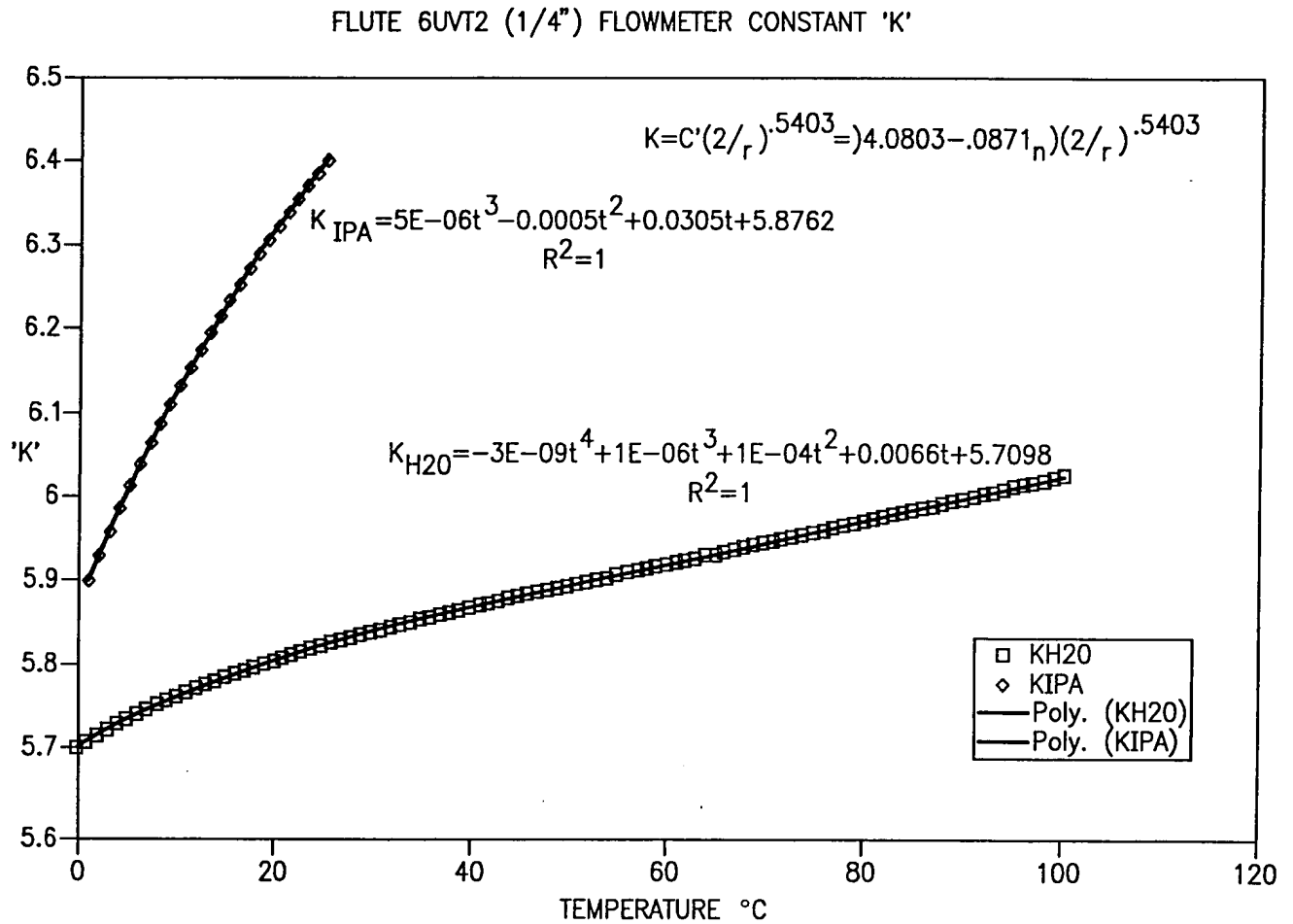


FIG. 18



## VOLUMETRIC FLOW RATE vs PRESSURE DROP FOR FLUTE 6UVT2 (1/4")

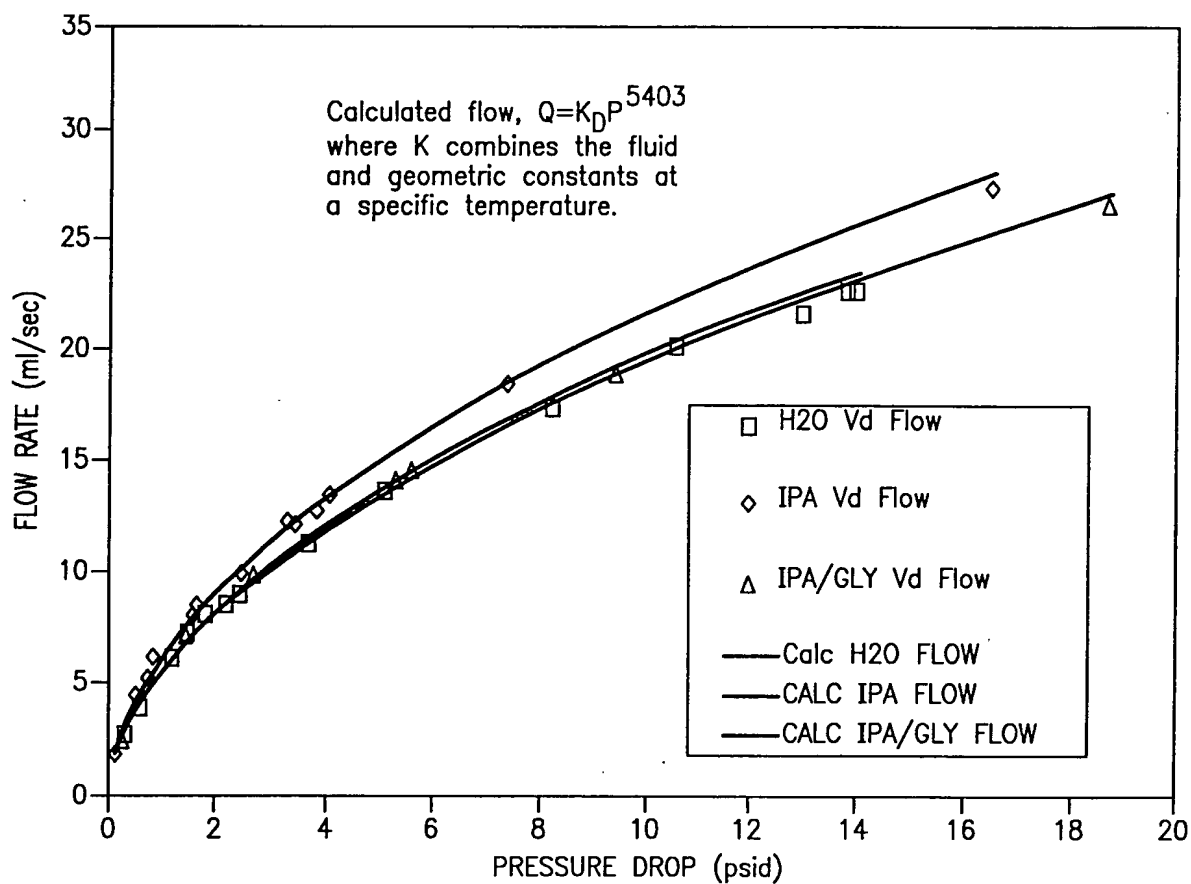


FIG. 19

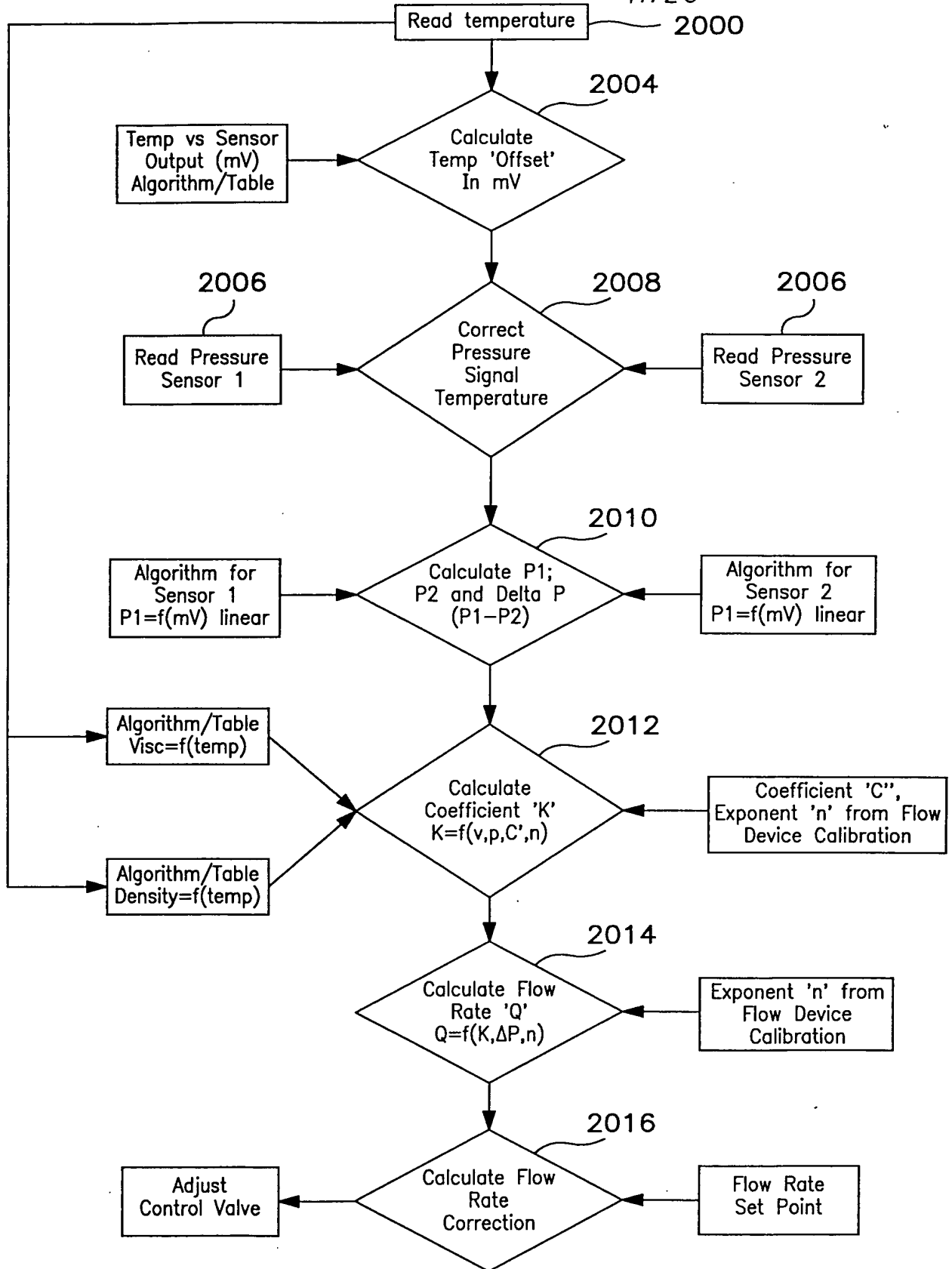


FIG. 20

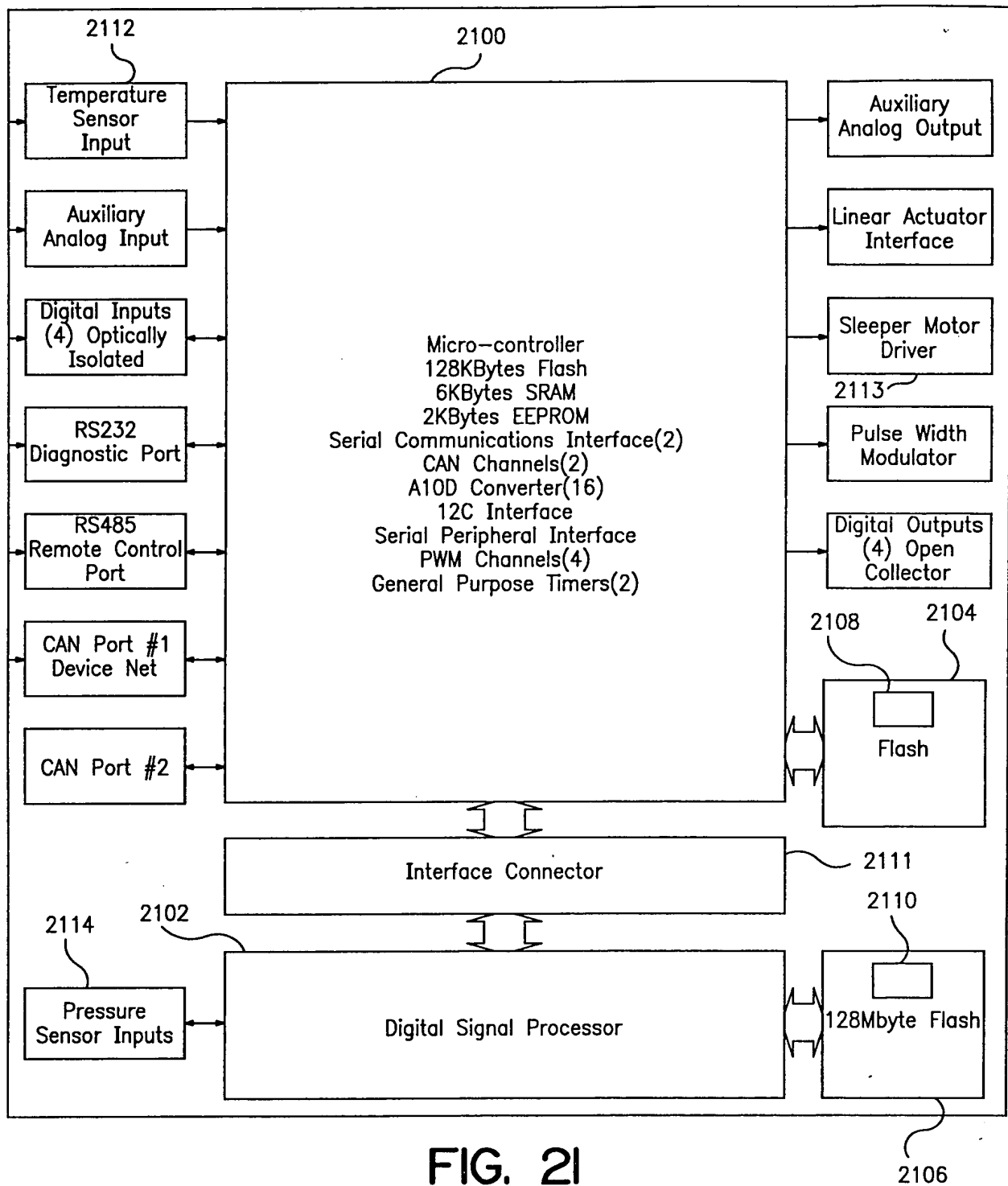


FIG. 21

As long as the fluid speed is sufficiently subsonic ( $V < \text{mach } 0.3$ ), the incompressible Bernoulli's equation describes the flow. Applying this equation to a streamline traveling down the axis of the horizontal tube gives,

$$P_a - P_b = \Delta p = \frac{1}{2} \rho V_b^2 - \frac{1}{2} \rho V_a^2$$

From continuity, the throat velocity  $V_b$  can be substituted out of the above equation to give,

$$\Delta p = \frac{1}{2} \rho V_a^2 \left[ \left( \frac{A_a}{A_b} \right)^2 - 1 \right]$$

Solving for the upstream velocity  $V_a$  and multiplying by the cross-sectional area  $A_a$  gives the volumetric flowrate  $Q$ ,

$$Q = \sqrt{\frac{2\Delta p}{\rho}} \frac{A_a}{\sqrt{\left( \frac{A_a}{A_b} \right)^2 - 1}}$$

Ideal, inviscid fluids would obey the above equation. The small amounts of energy converted into heat within viscous boundary layers tend to lower the actual velocity of real fluids somewhat. A **discharge coefficient  $C$**  is typically introduced to account for the viscosity of fluids,

$$Q = C \sqrt{\frac{2\Delta p}{\rho}} \frac{A_a}{\sqrt{\left( \frac{A_a}{A_b} \right)^2 - 1}}$$

FIG. 22

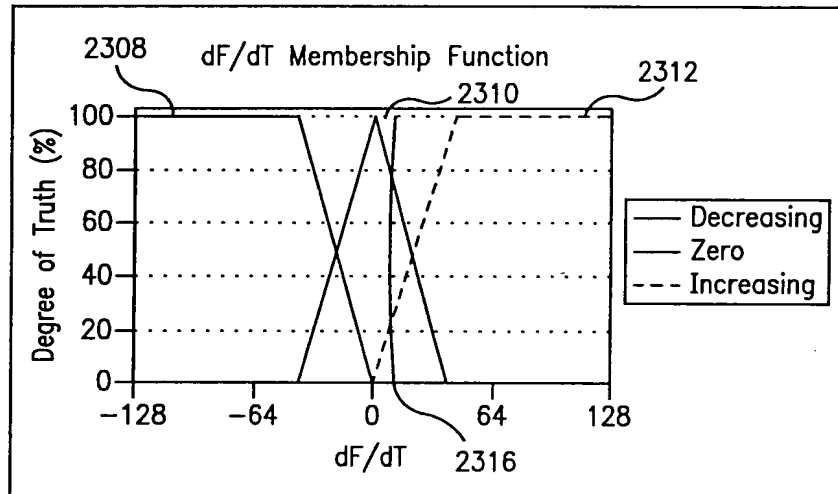


FIG. 23B

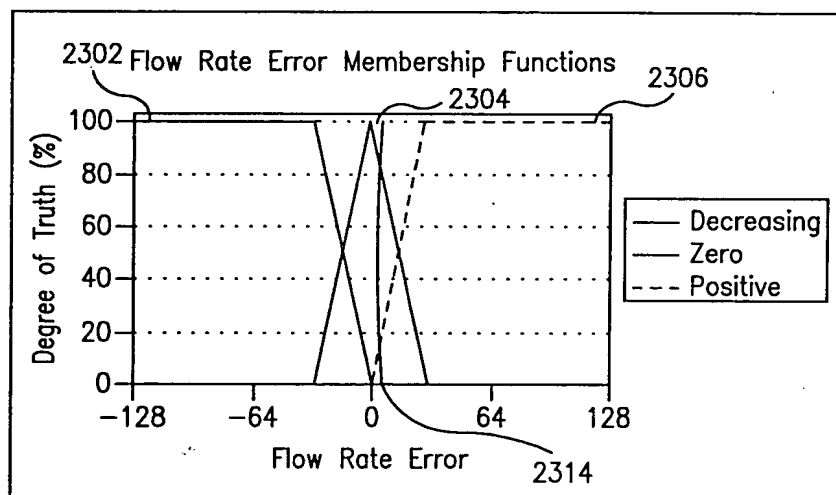


FIG. 23A